odorant and the methane
in the odorized natural gas to be sorptively stored
therein; and

means for selectively releasing the stored and
pressurized odorized natural
gas from the vessel, the **sorbent** material thereby
desorptively releasing the
odorized natural gas with the odorant present therein in at
least said
predetermined minimum concentration level as the pressure
in the vessel
decreases during the said release.

61. An apparatus according to claim 60, wherein the
sorbent material is an
adsorbent material.

63. An apparatus according to claim 60, wherein the
sorbent material is an
absorbent material.

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	Type	L #	Hits	Search Text	DBs	Time Stamp
1	BRS	L1	813	141/18,21.ccls.	USPAT	2003/04/10 12:20
2	BRS	L143	171	141/3.ccls.	USPAT	2003/04/10 12:20
3	BRS	L144	526	141/67.ccls.	USPAT	2003/04/10 12:20
4	BRS	L145	199	141/89.ccls.	USPAT	2003/04/10 12:20
5	BRS	L146	279	141/91.ccls.	USPAT	2003/04/10 12:21
6	BRS	L147	321	141/100.ccls.	USPAT	2003/04/10 12:21
7	BRS	L148	276	141/105.ccls.	USPAT	2003/04/10 12:21
8	BRS	L149	1636	141/3,67,89,91,100,105.ccls.	USPAT	2003/04/10 12:22
9	BRS	L151	10	150 and purity	USPAT	2003/04/10 12:23
10	BRS	L150	152	149 and manifold	USPAT	2003/04/10 12:56
11	BRS	L152	1	149 and ampoule	USPAT	2003/04/10 12:28
12	IS&R	L153	3	(("6062275") or ("6247509") or ("6382271")).PN.	USPAT	2003/04/10 12:57

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TITLE: Method and apparatus for sorptively storing a multiconstituent gas

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The disclosure relates to a method and apparatus for sorptively storing a multiconstituent gas in, and for selectively releasing the multiconstituent gas from, a vessel having a predetermined **sorbent** material therein, while substantially preserving minimum quantities or concentrations of certain constituents of the gas. In such a method and apparatus, a first of the constituents of the multiconstituent gas which is preferentially sorbed by the **sorbent** material, is present in the multiconstituent gas in a predetermined minimum concentration level substantially less than that of the second constituent. First, the **sorbent** material in the vessel is sorptively saturated with a pre-storage quantity of the first constituent at a first predetermined pressure. Then the multiconstituent gas to be stored is introduced under pressure into the vessel, with the vessel being pressurized to a second predetermined pressure above the first predetermined pressure. Thus both of the first and second constituents are sorptively stored in the vessel on the **sorbent** material therein. When the stored multiconstituent gas is selectively released from the vessel, the **sorbent** material desorptively release the multiconstituent gas with the first constituent being present in at least the

above-mentioned predetermined concentration as the pressure in the vessel
decreases.

The present invention relates generally to a method and apparatus for
sorptively storing a multiconstituent gas, such as an odorized natural gas or
other multiconstituent gaseous fuel, in a storage vessel having a **sorbent**
material therein. More particularly, the present invention relates to such a
method and apparatus for substantially preserving a relative concentration of
at least one of the constituents of the multiconstituent gas at a predetermined
minimum concentration level relative to other constituents of the
multiconstituent gas, both before and after sorptive storage in the storage
vessel. It should be noted that the terms "**sorbent**" and "sorptive", and the
like, as used herein, refer to the use of either an adsorbent or an absorbent
material.

While the above-mentioned systems and apparatuses for gaseous fuel storage
have proved to be highly advantageous, the use of **sorbent** materials for such
storage frequently results in the removal of odorants or other desirable
additives or constituents that have been included in such gaseous fuels for
safety purposes or for other reasons deemed necessary or desirable in a
particular application. Such undesirable removal of odorant additives or other
desirable constituents of a multiconstituent gas typically results from the
fact that such odorants, additives, or other desirable constituents frequently
include heavier, longer-chain compounds that are preferentially sorbed
(absorbed or adsorbed) by the **sorbent** material relative to the other
constituents of the gaseous fuel or other gas. Consequently, although such

preferentially sorbed materials are present in the gaseous fuel or other gas in predetermined minimum desirable concentrations in the gas supplied to the storage apparatus, the preferential sorption of these materials in the storage tank or vessel causes them to be substantially removed, or at least reduced to undesirably low levels, when the stored gas is removed from the storage vessel for use.

In accordance with the present invention, a method and apparatus is provided for sorptively storing a multiconstituent gas in, and for selectively releasing the multiconstituent gas from, a vessel having a predetermined **sorbent** material therein, while substantially preserving minimum quantities or concentrations of certain constituents of the gas. In such a method and apparatus, a first of the constituents of the multiconstituent gas, which is preferentially sorbed by the predetermined **sorbent** material, is present in the multiconstituent gas in a predetermined minimum quantity or concentration level substantially less than the quantity of the second constituent. First, the **sorbent** material in the vessel is sorptively saturated with a pre-storage quantity of the first constituent at a first predetermined pressure. Then the multiconstituent gas to be stored is introduced under pressure into the vessel, with the vessel being pressurized to a second predetermined pressure that is higher than the above-mentioned first predetermined pressure. This causes both of the first and second constituents of the multiconstituent gas to be sorptively stored in the vessel on the **sorbent** material therein.

When the stored and pressurized multiconstituent gas is selectively released from the vessel, the **sorbent** material therein desorptively releases the

multiconstituent gas, with the first constituent being present in at least the above-mentioned predetermined quantity or concentration, as the pressure in the vessel decreases during the desorptive release of the stored gas. Effectively, because of the pre-storage saturation of the **sorbent** material with the desired first constituent at a first predetermined pressure level, the desired concentration level of such preferentially-sorbed first constituent is substantially preserved in the stored multiconstituent gas being withdrawn from the storage vessel for use in a gas-consuming system or other application.

In one preferred embodiment of the invention, the above-mentioned first predetermined pressure, at which the **sorbent** material is sorptively saturated, is approximately equal to atmospheric pressure, but other pressures may also be desired in particular applications. Thus, when the multiconstituent gas is introduced into the storage vessel for sorptive storage therein, it is pressurized to a second predetermined pressure higher than the preferred atmospheric first predetermined pressure. Preferably, the pre-storage quantity of the first constituent is introduced into the **sorbent** material for sorptive saturation in a gaseous state. However, because such first constituents frequently have vapor pressures lower than the first predetermined saturation pressure, such constituents can alternatively be introduced in a liquid state, with the **sorbent** material sorptively retaining the first constituent in a gaseous state.

Also, in the preferred form of the invention, the **sorbent** material is sorptively saturated in the manner described above after the **sorbent** material is placed in the storage vessel. Alternatively, however,

if deemed necessary
or desirable in a particular application, such sorptive saturation can be
performed prior to the **sorbent** material being placed in, or otherwise
associated with, the storage vessel.

FIG. 2 is a series of curves illustrating the relationship of pressure and
stored quantity of various gases adsorbed or absorbed by a **sorbent** material.

FIGS. 1 through 3 depict exemplary embodiments, for purposes of
illustration, of a **sorbent** gaseous fuel storage apparatus and method for use in
the method according to the present invention. One skilled in the art will
readily recognize from the following discussion, taken in conjunction with the
accompanying drawings and the appended claims, that the principles of the
present invention are equally applicable to embodiments of **sorbent** gas storage
systems other than the particular embodiments shown in the drawings. In this
regard, it should be particularly emphasized that the drawings depict one
application of the invention for storage of an odorized natural gas, to which
an odorant has been added in predetermined small concentration levels in order
to allow for the detection of leaks or other undesired releases of the natural
gas from piping or other gas systems, but the invention is not limited to this
particular application.

Referring to FIG. 1, a storage vessel 10 includes a **sorbent** material 12
therein for sorptively storing a multiconstituent gas introduced into the
storage vessel 10. Although the **sorbent** material 12 is preferably composed of
an adsorbent material, such as activated carbon, zeolite, silica gel, or clay,
for example, various other adsorbents or absorbents known to those skilled in

the art can alternatively be employed.

Also in like manner, the apparatus optionally, but preferably, includes a vacuum or depressurizing apparatus 22, with a vacuum conduit or pipe 24, a shut-off valve 26, and a vacuum supply connector 28. The vacuum supply connector is releasably connectable to the connector 20 for the optional, but preferred, depressurization of the vessel 10 prior to pre-storage saturation of the **sorbent** material 12, as is explained more fully below.

In addition, the **sorbent** material 12 is optionally, but preferably, heated by a heating apparatus 38 during the above-mentioned depressurization prior to pre-storage odorant saturation. Such heating tends to release any undesirable contaminants or other substances previously sorbed by the **sorbent** material 12, thus increasing its useful storage capability.

Because the odorant, or other predetermined constituent of a multiconstituent gas, from the source 40 typically is a heavier, longer-chain material, when compared with the other constituents of the natural gas (primarily methane) or other multiconstituent gas, the **sorbent** material 12 is capable of isothermally storing a much larger quantity (volume or mass) of the odorant than the methane at various storage pressures. Similarly, the storable quantity of pure odorant varies much more rapidly with storage pressure than does the mixture of odorant and methane, i.e. the odorized natural gas, from the source 30. The phenomenon is illustrated diagrammatically in FIG. 2, wherein various isothermic curves for pure odorant, odorized natural gas, and methane are illustrated and indicated by reference numerals 48, 50, and 52, respectively.

Because of the preferential sorptive storage phenomenon discussed above, the introduction of odorized natural gas from the source 30 into the storage vessel 10 results in the **sorbent** material 12 preferentially sorbing, and thus retaining, the odorant in the odorized natural gas upon release of the stored odorized natural gas from the storage vessel 10 for use in a natural gas consuming device or other natural gas system. This effect is undesirable since the purpose of the addition of odorant in small concentration levels, typically in the range of approximately two parts per million to approximately ten parts per million, is required and desirable in order to allow for the detection of leakage or other undesired natural gas releases in a gas-consuming system.

Consequently, in accordance with the present invention, the storage vessel 10 is preferably initially depressurized or evacuated (by way of connection of the vacuum apparatus 22 to the vessel 10) to a low pressure below atmospheric pressure, preferably at or close to zero absolute pressure. In addition, the **sorbent** material 12 is preferably heated during such depressurization, as mentioned above. Next, the odorant supply connector 46 is releasably connected with the connector 20 and the shut-off valves 18 and 44 are opened in order to introduce a supply of pure odorant from the source 40 under pressure into the storage vessel 10.

The initial pre-storage charge of the odorant from the source 40 is introduced under pressure preferably to a pressure level approximately equal to atmospheric pressure, and the **sorbent** material 12 in the storage vessel 10 is allowed to become sorptively saturated at approximately atmospheric pressure. Such saturation is not necessarily a total saturation, with

the **sorbent** material being left in a partially saturated condition capable of storing the desired quantity of odorized natural gas at elevated pressures. The shut-off valves 18 and 44 are then closed, and the odorant supply connector 46 is disconnected from the connector 20. The storage vessel 10 is now charged with its pre-storage saturation level of pure odorant and is thus ready for use for storage of odorized natural gas from the source 30.

In order to load the storage vessel 10 with odorized natural gas for sorptive storage and subsequent use, the gas supply connector 36 is releasably connected with the connector 20, and the shut-off valves 18 and 34 are opened in order to introduce odorized natural gas from the source 30 into the storage vessel 10 under pressure. Such pressurized introduction of the odorized natural gas from the source 30 into the storage vessel 10 continues until a sufficient quantity of odorized natural gas is stored at a predetermined desired storage pressure, which is substantially higher than the preferred atmospheric pressure at which the **sorbent** material 12 was previously sorptively saturated, thus allowing the odorized natural gas from the source 30 to be stored in the storage vessel 10. During such storage, and because of the increased pressure, the **sorbent** material is allowed to sorptively store both the odorant and methane constituents of the odorized natural gas from the source 30. When the storage loading of the odorized natural gas from the source 30 is completed, with the odorized natural gas being sorptively stored at a predetermined desired storage pressure, the shut-off valves 18 and 34 are closed and the gas supply connector 36 is disconnected from the connector 20.

Subsequently, when use of the stored odorized natural gas is desired, the connector 20 can be releasably connected to a gas-consuming device or other gas system, and the shut-off valve 18 can be opened in order to desorptively release the stored odorized natural gas from the storage vessel 10 for use. During such release, in which the pressure of the odorized natural gas in the storage vessel 10 decreases, the **sorbent** material 12 in the storage vessel 10 releases both the odorant and the methane constituents of the odorized natural gas, as diagrammically illustrated by isothermic curve 50 in FIG. 2. Such release, with the odorant present in the odorized natural gas at or above the predetermined minimum concentration levels, occurs as the pressure drops from the storage pressure toward atmospheric pressure because the **sorbent** material 12 in the storage vessel 10 has already been saturated with nearly all the pure odorant that it can sorptively hold at atmospheric pressure, and thus it desorbs and releases the mixture of odorized natural gas during release of the stored odorized natural gas from the storage vessel 10.

Although the **sorbent** material 12 within the storage vessel 10 is preferably saturated with a pre-storage quantity of odorant after the **sorbent** material 12 is placed within the storage vessel 10, such pre-storage sorptive saturation can alternatively be performed prior to placing the saturated **sorbent** material in fluid communication or fluid flow association with the storage vessel 10. This alternate arrangement is illustrated in FIG. 3, wherein a storage vessel 110 similar to the storage vessel 10 has previously been loaded with a **sorbent** material in a manner similar to that illustrated in FIG. 1. A **sorbent** saturation cartridge in 160 is connected in fluid communication with the

storage vessel 110 and includes a predetermined quantity of a **sorbent** material 112 therein. Preferably, the **sorbent** saturation cartridge 160 is placed in fluid communication between the storage vessel 110 and an inlet/outlet apparatus 114, which is substantially identical to the inlet/outlet 14 described above.

Prior to being connected as indicated above, the **sorbent** saturation cartridge 160 has been preferably evacuated to a low pressure substantially below atmospheric pressure, and then sorptively saturated with pure odorant in a manner similar to that described above in connection with the preferred apparatus shown in FIG. 1. Thus, as the odorized natural gas is introduced from the source 30 (see FIG. 1) under pressure in the manner described above, the increase in pressure allows the **sorbent** material 112 in the **sorbent** saturation cartridge 160 to sorptively retain more of the pure odorant from the source 40 (see FIG. 1). After the storage vessel 110 has been fully loaded, and the stored odorized natural gas is released for use, the pressure within the storage vessel 110 and the **sorbent** saturation cartridge 160 correspondingly decreases, forcing the **sorbent** material 112 in the **sorbent** saturation cartridge 160 to release pure odorant into the outgoing flow of natural gas, thus releasing an odorized natural gas with the minimum desired concentration level of odorant being substantially preserved.

As one skilled in the art will readily recognize, the cartridge 160, with the saturated **sorbent** material therein, can also alternatively be used to release an odorant or other desired materials into a previously non-odorized gas stream, or into a gas not previously containing such desired materials.

In any of the embodiments of the present invention illustrated in FIGS. 1 through 3 and described above, the **sorbent** material 12 or 112 can be sorptively saturated by a pre-storage quantity of odorant from the source 40, wherein the pure odorant is preferentially sorptively introduced for saturation in a gaseous state, or alternatively sorptively introduced for saturation in a liquid state. Because the vapor pressure of the pure odorant is typically substantially less than atmospheric pressure, such introduction in a liqiud state results in the odorant being sorbed for saturation by the **sorbent** material 12 or 112, at least partially in a gaseous state. Such introduction in a liquid state may be desirable for speed or convenience in a particular application.

1. A method for sorptively storing a multiconstituent gas in, and for selectively releasing the multiconstituent gas from, a vessel having a predetermined **sorbent** material therein, the multiconstituent gas being composed of at least two constituents, a first of the constituents being preferentially sorbed by the predetermined **sorbent** material over a second of the constituents, and the first of the constituents being present in the multiconstituent gas in a predetermined minimum quantity substantially less than the quantity of the second constituent present in the multiconstituent gas, said method being adapted for substantially preventing the first constituent from being substantially sorptively removed from the multiconstituent gas upon release of the stored multiconstituent gas from the vessel, said method comprising the steps of:

sorptively saturating the **sorbent** material in the vessel

with a pre-storage
quantity of the first constituent at a first predetermined
pressure;

introducing the multiconstituent gas under pressure into
the vessel after
the **sorbent** material has been sorptively saturated and
pressurizing the vessel
with the multiconstituent gas to a second predetermined
pressure higher than
said first predetermined pressure in order to cause both of
the first and
second constituents of the multiconstituent gas to be
sorptively stored
therein; and

selectively releasing the stored and pressurized
multiconstituent gas from
the vessel, the **sorbent** material thereby desorptively
releasing the
multiconstituent gas with the first constituent present
therein in at least
said predetermined minimum quantity, as the pressure in the
vessel decreases
during said release.

3. A method according to claim 1, further comprising
the step of
depressurizing the vessel to a pressure lower than said
first predetermined
pressure prior to said step of sorptively saturating the
sorbent material.

6. A method according to claim 5, further comprising
the step of
depressurizing the vessel to a pressure below said first
predetermined pressure
prior to said step of sorptively saturating the **sorbent**
material.

8. A method according to claim 1, wherein said
sorptively saturating step
includes the step of sorptively introducing the first
constituent into the
vessel in a liquid state, the first constituent having a
sufficiently low vapor
pressure to allow at least a portion of said pre-storage
quantity of said

liquid first constituent to be sorbed by the **sorbent** material in a gaseous state at said first predetermined pressure.

9. A method according to claim 8, further comprising the step of depressurizing the vessel to a pressure below said first predetermined pressure prior to said step of sorptively saturating the **sorbent** material.

11. A method according to claim 1, wherein the **sorbent** material is an adsorbent material.

13. A method according to claim 1, wherein said **sorbent** material is an absorbent material.

15. A method according to claim 1, wherein the **sorbent** material is sorptively saturated with said pre-storage quantity of the first constituent after being placed in the vessel.

16. A method according to claim 1, wherein the **sorbent** material is sorptively saturated with said pre-storage quantity of the first constituent prior to being placed in fluid flow association with the vessel.

17. A method for sorptively storing an odorized natural gas in a vessel having a predetermined **sorbent** material therein, the odorized natural gas including at least a mixture of an odorant and methane, with the odorant being preferentially sorbed over the methane, and for selectively releasing the stored natural gas from the vessel in an odorized condition wherein the concentration of the odorant in the natural gas is at or above a predetermined minimum concentration level both before and after being sorptively stored in the vessel, said method comprising the steps of:

sorptively saturating the **sorbent** material in the vessel with a pre-storage quantity of the odorant at a first predetermined pressure;

introducing the odorized natural gas under pressure into vessel after the **sorbent** material has been sorptively saturated with the odorant and pressurizing the vessel with the odorized natural gas to a second predetermined pressure higher than said first predetermined pressure in order to cause both the odorant and the methane constituents of the odorized natural gas to be sorptively stored therein; and

selectively releasing the stored and pressurized odorized natural gas from the vessel, the **sorbent** material thereby desorptively releasing the odorized natural gas with the odorant present therein in at least the predetermined minimum concentration level as the pressure in the vessel decreases during said release.

19. A method according to claim 17, further comprising the step of depressurizing the vessel to a pressure lower than said first predetermined pressure prior to said step of sorptively saturating the **sorbent** material.

22. A method according to claim 21, further comprising the step of depressurizing the vessel to a pressure below said first predetermined pressure prior to said step of sorptively saturating the **sorbent** material.

24. A method according to claim 17, wherein said sorptively saturating step includes the step of introducing said pre-storage quantity of the odorant into the vessel in a liquid state, the odorant having a sufficiently low vapor pressure to allow at least a portion of said pre-storage quantity of said

liquid odorant to be sorbed by the **sorbent** material in a gaseous state at said
first predetermined pressure.

25. A method according to claim 24, further comprising the step of
depressurizing the vessel to a presure below said first predetermined pressure
prior to said step of sorptively saturating the **sorbent** material.

27. A method according to claim 17, wherein the **sorbent** material is an
adsorbent material.

29. A method according to claim 17, wherein said **sorbent** material is an
absorbent material.

31. A method according to claim 17, wherein the **sorbent** material is
sorptively saturated with the odorant after being placed in the vessel.

32. A method according to claim 17, wherein the **sorbent** material is
sorptively saturated with the odorant prior to being placed in the vessel.

33. A method for sorptively storing an odorized natural gas in a vessel
having a predetermined **sorbent** material therein, the odorized natural gas
including a mixture of at least an odorant and methane, with the odorant being
preferentially sorbed by the **sorbent** material over the methane, and for
selectively releasing the stored natural gas from the vessel in an odorized
condition wherein the concentration of the odorant in the natural gas is at or
above a predetermined minimum concentration level both before and after being
sorptively stored in the vessel, said method comprising:

depressurizing the **sorbent** material to a pressure substantially below

atmospheric pressure;

sorptively saturating the **sorbent** material with a quantity of the odorant to a first pressure substantially equal to atmospheric pressure;

introducing the odorized natural gas under pressure into the vessel after the **sorbent** material has been sorptively saturated to a pressure above atmospheric pressure in order to cause both the odorant and the methane in the odorized natural gas to be sorptively stored therein; and selectively releasing the stored and pressurized odorized natural gas from the vessel, the **sorbent** material thereby desorptively releasing the odorized natural gas with the odorant present therein in at least said predetermined minimum concentration level as the pressure in the vessel decreases during the said release.

34. A method according to claim 33, wherein said sorptively saturating step includes the step of sorptively introducing said quantity of the odorant into the **sorbent** material in a gaseous state.

35. A method according to claim 33, wherein said saturating step includes the step of sorptively introducing said quantity of the odorant into the vessel in a liquid state, the odorant having a sufficiently low vapor pressure to allow at least a portion of said quantity of said liquid odorant to be sorbed by the **sorbent** material in a gaseous state at atmospheric pressure.

36. A method according to claim 33, wherein the **sorbent** material is an adsorbent material.

38. A method according to claim 33, wherein the **sorbent** material is an

absorbent material.

40. A method according to claim 33, wherein the **sorbent** material is
sorptively saturated with said quantity of the odorant after being placed in
the vessel.

41. A method according to claim 33, wherein the **sorbent** material is
sorptively saturated with said quantity of the odorant prior to being placed in
fluid flow association with the vessel.

42. An apparatus for sorptively storing a multiconstituent gas in, and for
selectively releasing the multiconstituent gas from, a vessel having a
predetermined **sorbent** material therein, the multiconstituent gas being composed
of at least two constituents, a first of the constituents being preferentially
sorbed by the predetermined **sorbent** material over a second of the constituents,
and the first of the constituents being present in the multiconstituent gas in
a predetermined minimum quantity substantially less than the quantity of the
second constituent present in the multiconstituent gas, said apparatus being
adapted for substantially preventing the first constituent from being
substantially sorptively removed from the multiconstituent gas upon release of
the stored multiconstituent gas from the vessel, said apparatus comprising:

means for sorptively saturating the **sorbent** material in the vessel with a
pre-storage quantity of the first constituent at a first predetermined
pressure;

means for introducing the multiconstituent gas under pressure into the
vessel after the **sorbent** material has been sorptively saturated and
pressurizing the vessel with the multiconstituent gas to a

second predetermined
pressure higher than said first predetermined pressure in order to cause both
of the first and second constituents of the multiconstituent gas to be
sorptively stored therein; and

means for selectively releasing the stored and pressurized multiconstituent
gas from the vessel, the **sorbent** material thereby desorptively releasing the
multiconstituent gas with the first constituent present therein in at least
said predetermined minimum quantity, as the pressure in the vessel decreases
during said release.

44. An apparatus according to claim 42, further comprising means for
depressurizing the vessel to a pressure lower than said first predetermined
pressure prior to sorptively saturating the **sorbent** material.

46. An apparatus according to claim 42, wherein the **sorbent** material is an
adsorbent material.

48. An apparatus according to claim 42, wherein said **sorbent** material is an
absorbent material.

49. An apparatus according to claim 42, wherein the **sorbent** material is
sorptively saturated with said pre-storage quantity of the first constituent
after being placed in the vessel.

50. An apparatus according to claim 42, wherein the **sorbent** material is
sorptively saturated with said pre-storage quantity of the first constituent
prior to being placed in fluid flow association with the vessel.

51. An apparatus for sorptively storing an odorized natural gas in a vessel
having a predetermined **sorbent** material therein, the

odorized natural gas
including at least a mixture of an odorant and methane, with the odorant being
preferentially sorbed over the methane, and for selectively releasing the
stored natural gas from the vessel in an odorized condition wherein the
concentration of the odorant in the natural gas is at or above a predetermined
minimum concentration level both before and after being sorptively stored in
the vessel, said apparatus comprising:

means for sorptively saturating the **sorbent** material in the vessel with a
pre-storage quantity of the odorant at a first predetermined pressure;

means for introducing the odorized natural gas under pressure into vessel
after the **sorbent** material has been sorptively saturated with the odorant and
pressurizing the vessel with the odorized natural gas to a second predetermined
pressure higher than said first predetermined pressure in order to cause both
the odorant and the methane constituents of the odorized natural gas to be
sorptively stored therein; and

means for selectively releasing the stored and pressurized odorized natural
gas from the vessel, the **sorbent** material thereby desorptively releasing the
odorized natural gas with the odorant present therein in at least the
predetermined minimum concentration level as the pressure in the vessel
decreases during said release.

53. An apparatus according to claim 51, further comprising means for
depressurizing the vessel to a pressure lower than said first predetermined
pressure prior to said step of sorptively saturating the **sorbent** material.

55. An apparatus according to claim 51, wherein the

sorbent material is an
adsorbent material.

57. An apparatus according to claim 51, wherein said **sorbent** material is an
absorbent material.

58. An apparatus according to claim 51, wherein the **sorbent** material is
sorptively saturated with the odorant after being placed in the vessel.

59. An apparatus according to claim 51, wherein the **sorbent** material is
sorptively saturated with the odorant prior to being placed in the vessel.

60. An apparatus for sorptively storing an odorized natural gas in a vessel
having a predetermined **sorbent** material therein, the odorized natural gas
including a mixture of at least an odorant and methane, with the odorant being
preferentially sorbed by the **sorbent** material over the methane, and for
selectively releasing the stored natural gas from the vessel in an odorized
condition wherein the concentration of the odorant in the natural gas is at or
above a predetermined minimum concentration level both before and after being
sorptively stored in the vessel, said apparatus comprising:

means for depressurizing the **sorbent** material to a pressure substantially
below atmospheric pressure;

means for sorptively saturating the **sorbent** material with a quantity of the
odorant to a first pressure substantially equal to atmospheric pressure;

means for introducing the odorized natural gas under pressure into the
vessel after the **sorbent** material has been sorptively saturated to a pressure
above atmospheric pressure in order to cause both the